
Space Weather Technical Forecast

Issued on Monday, 24 April 2023 at 13:40 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Moderate or Strong geomagnetic storm/G2-G3 risk from CME effects continuing Day 1 (Monday 24 April) but easing. Slight chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only C-class flares observed. There are currently six numbered sunspot regions on the visible disc. AR3282 (Fho, Beta) approaching the northwest limb remains the largest grouping though slight fading observed. Its position near the limb is making classification increasingly difficult however. AR3285 (Eso, Beta) in the southeast is the second largest and remains generally stable. The remaining sunspot regions are all small and stable, including one new and currently unnumbered sunspot region in the far southeast.

The large full-halo CME (Coronal Mass Ejection) that left the Sun at 21/1812UTC from an M1.7 flare and associated filament eruption near center-disc arrived at L1 at 23/1700 UTC. No other Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1 and ACE, was initially at slow-ambient levels, but increased significantly to Elevated or Strong levels, briefly reaching Very Strong levels, with the arrival of the CME, with a peak speed of near 800km/s observed at 23/2140 UTC. The solar wind density was initially below average, increasing to above average with the arrival of the CME, with a peak of 33 ppcc observed at 23/1944 UTC, briefly declining to below average values before returning to average levels from around 24/0040 UTC. The IMF was initially weak, increasing to strong or very strong with the arrival of the CME, with a peak of 33.9nT observed at 24/0103 UTC as we looked to enter the magnetic cloud associated with the CME. The north-south component (Bz) started the period at weak levels, strengthening due to CME influence, with a maximum southward component of -25nT observed at 23/1808 UTC followed by a period of strong positive values before it fell back to very strong negative levels, with a minimum of -33.32nT observed at 24/0106 UTC. Since then it has shown a rising trend becoming weakly positive from 24/1030 UTC. The phi angle was mostly negative (towards the Sun), with brief orientations to positive (away from the Sun). The net effect of the above solar wind measures was geomagnetic activity increasing from G1-G2 Minor-Moderate Storm (Kp5-6) levels observed between 23/1200-1800 UTC, strengthening to a G3-G4 Strong to Severe Storm (Kp7-8) level between 23/1800-24/0900 UTC, before reducing to G2 Minor-Moderate Storm (Kp6) 24/0900-1200 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was slightly enhanced to start the period, following the M-class flare and filament eruption from 21/1812UTC, and reached above the S1 (storm level) following the arrival of the CME, with a peak value of 26 pfu observed at 23/1820 UTC before a general reduction back to background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was mostly at Normal Background levels. The associated 24-hour electron fluence was

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well below the Active threshold on a steady trend, with 1.47e6 integrated pfu observed at 24/0001UTC.

Four-Day Space Weather Forecast Summary

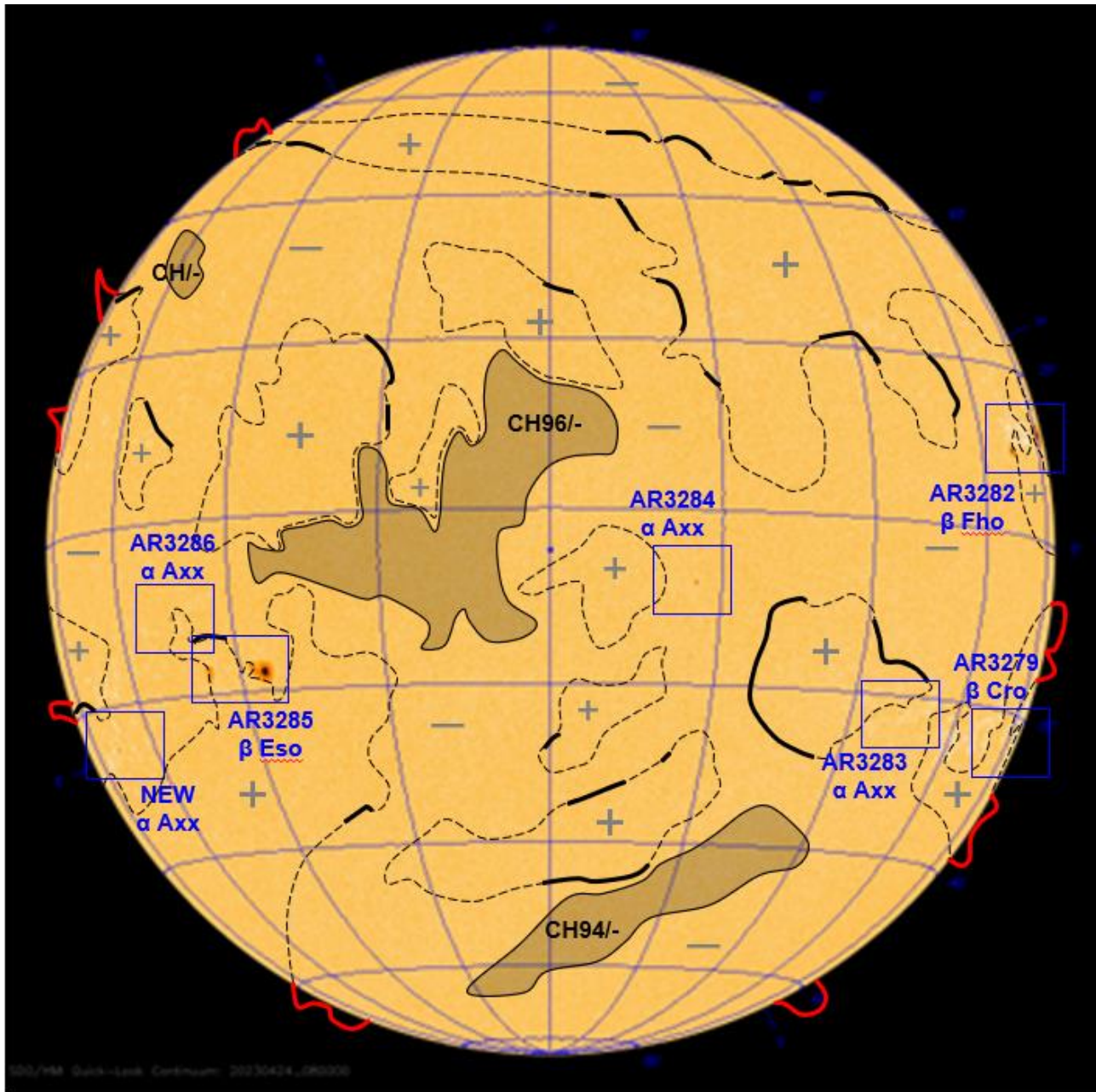
Solar Activity: A Slight Chance of isolated Moderate activity, otherwise Solar activity is most likely to remain Low.

Solar Wind / Geomagnetic Activity: Earth is currently experiencing the impacts from the full halo CME which left the Sun on 21 Apr. Solar winds are likely to remain Elevated during day 1 (24 Apr) due to on-going CME effects, before declining to Slightly Elevated on day 2 (25 Apr), perhaps briefly reaching background levels early day 3 (26 Apr). A gradual increase back up to Elevated levels likely later on day 3 and into day 4 (26/27 Apr) due to the expected arrival of a CIR/HSS from CH96/-.

Geomagnetic activity maintaining a chance of further G3 Strong Storm levels (Kp7) during day 1 (24 Apr) with further G1-G2 Minor-Moderate storms (Kp5-6) expected due to the on-going CME effects. Activity gradually reducing to generally Unsettled or Active intervals (Kp3-4) on day 2 (25 Apr), perhaps reaching Quiet to Unsettled intervals into day 3 as CME effects continue to wane. However, HSS and proceeding CIR from CH96/- later on day 3 and day 4 (26/27 Apr) likely increasing geomagnetic activity to Unsettled or Active intervals (Kp3-4), with a Chance of G1 Minor Storms (Kp 5).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to persist at Background levels, although there is a slight chance of S1 or greater, mainly due to on-going CME effects and any significant flares. High energy (greater than 2MeV) electron flux is currently at Background levels, with little change expected, although a slight increase is possible later in the period as CME effects likely wane. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 24/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Earth is currently experiencing the impacts from the full halo CME which left the Sun on 21 Apr, with solar winds at Elevated levels. Geomagnetic activity has recently reached G3-G4 Strong to Severe Storm (Kp7-8) levels due to the arrival of the CME. Solar winds are likely to remain Elevated during day 1 (24 Apr) due to on-going CME effects, before declining to Slightly Elevated on day 2 (25 Apr), perhaps briefly reaching background levels early day 3 (26 Apr). A gradual increase back up to Elevated levels likely later on day 3 and into day 4 (26/27 Apr) due to the expected arrival of a CIR/HSS from CH96/-.

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Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	100	60	20	30
Strong	G3	Yes	50	20	1	5
Severe	G4	Yes	10	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Nil

Figure 2: Latest L1 Magnetometer, showing arrival of CME shock at L1 and likely magnetic cloud signal from approximately 24/0100 UTC.

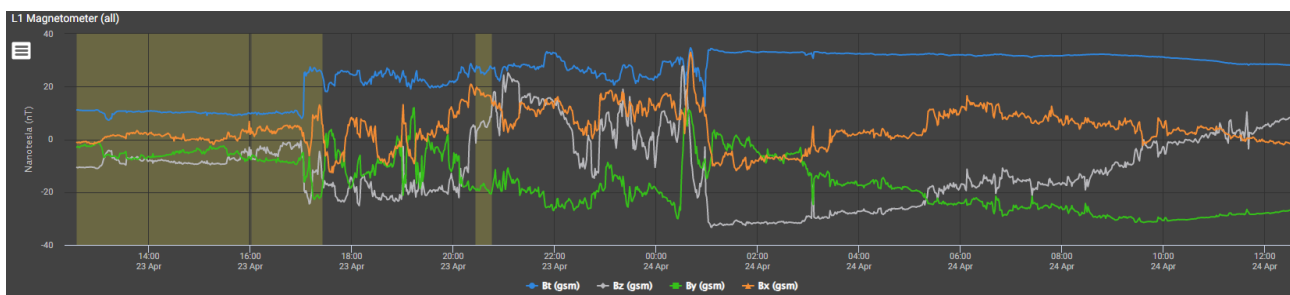
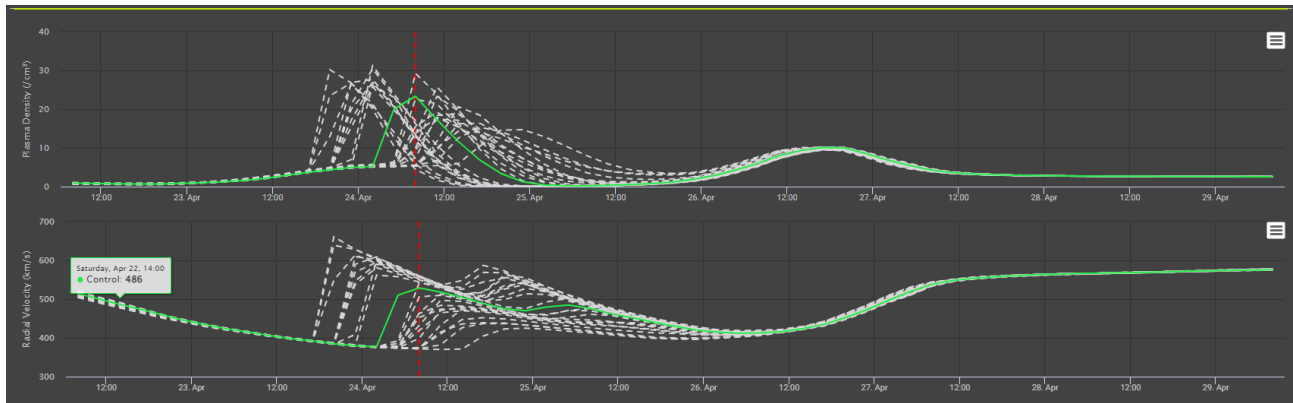


Figure 3: Latest MOSWOC ENLIL ensemble output showing range of CME arrival times and likely enhancement into the period associated with CH96/-.



Radio Blackouts - X-Ray Flares:

There are currently six numbered sunspot regions on the visible disc. AR3282 (Fho, Beta) approaching the northwest limb remains the largest grouping though slight fading observed. Its position near the limb is making classification increasingly difficult however. AR3285 (Eso, Beta) in the southeast is the second largest and remains generally stable. The remaining sunspot regions are all small and stable, including one new and currently unnumbered sunspot region in the far southeast.

Far side imagery is indicating one or two new active regions could rotate across the eastern limb into the period with a likely increase in flare risk. However this is balanced by the departure of particularly AR3282 through days 1 and 2. Overall solar activity is likely to remain Low, with a slight chance of becoming Moderate given any isolated M-class flares. These most likely in the near term from AR3282.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	15	15	20
Very Active	R3 to R5 X Class	No	1	1	1	1

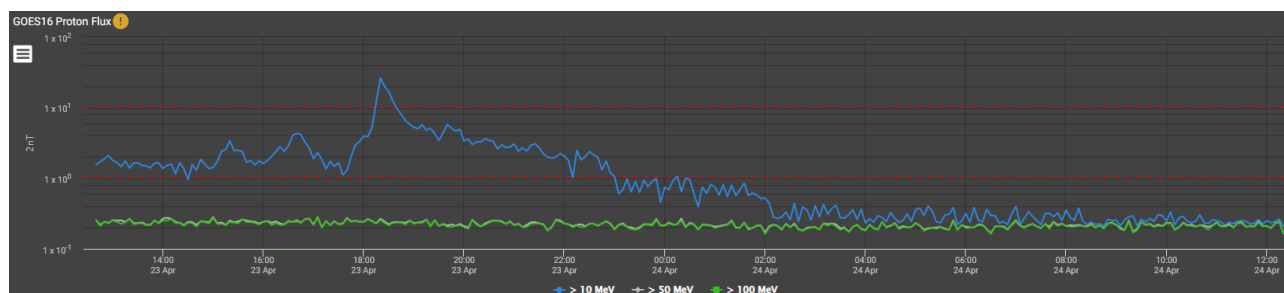
Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16, was briefly at Minor Storm levels (S1) due to the arrival of the large CME from 21 Apr but has returned towards background levels. There remains a slight chance of activity through day 1 (24 Apr) given continuing CME effects, but this reducing into the remainder of the period, mainly due to AR3282 rotating out of a favorable position on the disk and the lack of other significant active regions.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	Yes	10	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

Figure 4: Latest 24hr Proton Flux Trance



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy (greater than 2MeV) electron flux is currently at Background levels and are likely to remain at background levels due to on-going CME effects though the start of the period. Some enhancement possible into day 3 (26 Apr) as CME effects likely wane but HSS influence into the end of the period expected to once again suppress levels.

The associated 24-hour integrated fluence is therefore expected to remain below the Active threshold ($1\text{e}8$ integrated pfu), perhaps with an increasing trend later in the period.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	5	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5:

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